

Century Scale Evaporation Trend: An Observational Study

Abstract

Several climate models with different complexity indicate that under increased CO₂ forcing, runoff would increase faster than precipitation overland. However, observations over large U.S. watersheds indicate otherwise. This inconsistency between models and observations suggests that there may be important feedbacks between climate and land surface unaccounted for in the present generation of models.

We have analyzed century-scale observed annual runoff and precipitation time-series over several United States Geological Survey hydrological units covering large forested regions of the Eastern United States not affected by irrigation. Both time-series exhibit a positive long-term trend; however, in contrast to model results, these historic data records show that the rate of precipitation increases at roughly double the rate of runoff increase.

We considered several hydrological processes to close the water budget and found that none of these processes acting alone could account for the total water excess generated by the observed difference between precipitation and runoff. We conclude that evaporation has increased over the period of observations and show that the increasing trend in precipitation minus runoff is correlated to observed increase in vegetation density based on the longest available global satellite record. The increase in vegetation density has important implications for climate; it slows but does not alleviate the projected warming associated with greenhouse gases emission.